

The Role of University Library on Modern Engineering Education

Hsieh Sheng-Jii¹ & Lo Szu-Chia²

*The Institute of Aeronautics and Astronautics & The University Library
National Cheng Kung University, Tainan 701, TAIWAN, R.O.C.*

¹E-mail:sjhshieh@mail.ncku.edu.tw

²E-mail:losu@mail.ncku.edu.tw

Abstract: The objective of this study is to discuss the role of the university library in modern engineering education. The advanced development of the information technology which may affect the library functions of resources collection, distribution, relieving and reader services are firstly discussed. The role and modern features, services and operation of a university library in the cybernetic world are then suggested. The work of National Cheng Kung University Library is briefly introduced, and the results on qualify teaching, research, and extensive training programs are presented. Two strategies as to build a digital library and to provide an information literate program are suggested for becoming a modern university library. An undergraduate two-credit Information Literate course is presented and the effectiveness of the courseware work is discussed for references.

Keywords: Engineering Education; Web Internet; Digital Library.

1. Internet Cyber World

The coming 21st Century is the age of information science and technology. Due to the great development of the computer technology, and the fast advancement in space communication techniques, the new information and the advanced knowledge are spreading worldwide and penetrating into every part of the world. Knowledge is power. One who is able to achieve and master the information would definitely make him success, and so are the society and the Country. Therefore, most developing or developed countries nowadays are making great efforts to construct their information infrasture in order to provide a fast and efficient information highway to help their people on sharing and utilizing the information all over the world. Thus, the internet cyber world is developed and is growing fastly.

Because of providing a fast, efficient and easy way to access and search for the information, the global web internet systems become a huge treasure mountain that provides variety of informations in the forms of database, pictures, movies, multimedia or the interactive displays. Many academic and research institutions or leading universities in the world edit their own homepages to demonstrate their educational goals, academic activities, excellent training programs, and the innovative and important research results. Therefore, through these webpages and the resources linking with other websites, people can easily obtain new information, fresh knowledge, and learn how to solve their problems and do their creative works.

Engineering education is to train students to work in the high technology industrial world. Therefore, the engineering graduates must possess enough knowledges and skills to meet the challenging society needs. Due to the rapid progress of the advanced technology, both teachers and students have to keep in pace with the fast changing world. Since the global web network provides most of the new information and practical experiences that would certainly help the teaching, learning, and research work on engineering education. Therefore, the methods on retriving information and the utilization of helpful knowledge provided on the global web networks should be suggested to students in time; and some helpful teaching materials, fresh research findings, practical engineering problems and new results should be implemented in the course study.

2. Advances of Information Technology

The recent advancement in semi-conductor makes great achievement in computer technology. It is known that, nearly in every eighteen months, both memory and density of the chips and the speed of data transfer are doubled. Therefore, the personal computer nowadays are capable of doing huge computation in a short time interval, and providing a great memory space for storing huge amount of data. Due to these powerful features on storing and processing data, the function of computer software system and its application utilities are progressing fastly.

In the internet cyber world, people are able to communicate and exchange informations almost in real time scale. Huge amount of data transfer across computer systems only by mini-seconds, and the data can be any kind of hypertext documents or the multimedia. The WWW is a global hypertext document designed to allow people to work together. It is an internet-based hypermedia initiative for global information sharing. In addition, the hypertexts from many resources worldwide may use hyperlink and become an information network in the WWW. Therefore, utilizing the information at ones finger tip, one is able to retrieve the information or to catch up new knowledge. Accordingly, the WWW virture library and the WWW virtual university through the world internet are becoming true at the beginning of the 21st Century.

3. Infrastrure of Information Highway on Taiwan

In the early 1990's, the Republic of China government set up policies to lay internet infrastructure that can satisfy business requirements on Taiwan as well as needs for individual users. As of April 1, 1995, HiNet^{(1)*} was officially opened for operation. As today, HiNet is famous for its ultra high speed(ATM) backbone, and has built a vast international links that is among one of the best in the world. At present, registers of HiNet are more than three million that puts HiNet as one of the world top 5 ISPs. Currently, HiNet has built with a total 622 MBps of international bandwidth, and may upgrade in time to accommodate for the growing demands for its business.

On Taiwan, there are two main networks for academic and research purposes. These are Taiwan Academic Network(TANet) sponsored by the Ministry of Education, and the Science and Technology Information Center(STICNET) sponsored by the National Science Council. TANet is objective to serve schools and universities on Taiwan, whereas STICNET is established to provide national and international acedemic and research materials or resources for all people. Therefore, the infrastructure of the infermation highway on Taiwan is well established, and the networks for academic, research and life-long learning and education are well provided.

4. Main Features of University Library

The library is established for public to use the treasures embodied in books, manuscripts, and various form of materials. It has been working as an important information provider in the university. The functions of university library are to support teaching and advanced research for students, faculties and research staffs. As noted above that, due to great impacts of the advanced computer, global networking and the information technology, the functions and survice programs of the university library nowadays should be upgraded to meet the demanding of the fast advancing society.

Libraries today are providing electronic access to wide variety of resources, including indexes, full-text articles and complete journals. Building specific electronic collections of the library, promoting information technology, and speeding the documentation retrieving are the major tasks for modern university libraries. Therefore, university education does strongly tie with, and take the advantage of global networking systems.

The university library programs are underpinned by the concept of information literate. Unfortunately, lots of students still take the library as a reading space, they do not often use the informaiom provided by the library, and do not have the knowledge to locate, and/or to evaluate and use the information correctly. These concerns are more seriously now than in the past because the amount of information is growing exponentially. Therefore, short programs of introduction to the library or some library tours are very indispensible activities to help readers familiar with the library functions, services, library automation systems and the global informatics.

5. The Role of University Library

University or academic libraries are continuing to face the challenges of the expanding information services and the impact of the information technology. Although the academic libraries are closely connected to the teaching and research activities of the students and faculty on the campus, the roles of the academic libraries and

* Numbers in bracket desinated sequence of references at back of this paper.

librarians should also react timely to the information technology advancement. In despite mastering of the information technology, the academic libraries and librarians still also take the responsibility as an information provider to the university community. The responsibilities of the academic libraries are (1) to collect the proper information to support the couesrware work and research needs, and (2) to organize the information materials in a suitable way that makes the information access easily and efficiently. Evidently, the information technology helps to make the libraries and the librarians in delivering the information services effectively.

From the library operation to the information delivery, and from the reference tools to the full text electronic collection, it is realized that the library nowadays has to implement some sort of information technology to get things done well. Therefore, most of the libraries need to take two main strategies in response to the highly demanding society. One of the strategies is to expand the digital material collection, namely building a digital library. The other is to provide some proper instruction for both the librarians and the users to ensure them of being information literate. These two strategies, building a digital library and providing an information literate program, for becoming a modern university library are suggested as follows.

I. Building A Digital Library

Libraries today are providing electronic access to wide variety of resources, including indexes, full text articles and complete journals. Building electronic collection, promoting the use of information technology, speeding the information retrieval, and providing training programs are the major areas that modern academic libraries should mostly invest with. By developing these services, the library users could access the information more efficiently. As mentioned above that there are two main strategies or tasks for becoming a modern university library. The National Cheng Kung University(NCKU) Library in Tainan, Taiwan, R.O.C. has been devoted lots of efforts on these two tasks during last several years and has been continuing doing.

The National Cheng Kung University(NCKU) is one of the best comprehensive universities in Taiwan. The NCKU consists of six academic colleges. These colleges are Liberal Arts, Natural Sciences, Engineering, Management, Medicine, and Social Sciences. Besides these six colleges, there also has one well developed Medical Center, and many extensive education programs. The total numbers of students are 15,000. The NCKU Library is fully automated, and has been striving to build a digital library in the past several years. In addition to offer many kinds of services online, the Library also continues to allocate certain amount of budget on expanding the electronic collection, mainly on the reference databases and the journal collection. In order to expand the coverage of the electronic collection, the Library also joins CONCERT⁽²⁾ (Consortium on Core Electronic Resources in Taiwan) as a member for sharing and accessing to many other information resources. The following data shows the status of current electronic material collection of the NCKU Digital Library.

(I.1) Databases on the Intranet and Internet

To enhance the efficiency of the information retrieval, the NCKU Library offers the access to variety of reference databases, including the ready reference databases and literature indexes. Currently the Library provides more than 80 different databases and information systems; the topics cover from Arts and Humanities to Science and Engineering. In this collection, 40% of the databases are inter-discipline and 40% of them are sciences and engineering related subjects as shown in Table 1.

【 Table 1: The Databases in the NCKU Library Collection – by Subjects 】

General	Sciences & Engineering	Arts & Humanity	Management	Medical Sciences	Social Sciences	Total number of Titles
37	26	7	11	2	7	90
41.11%	28.89%	7.78%	12.22%	2.22%	7.78	100%

For the science and engineering databases, such as *Science Citation Index*, *IEL Online* and *EI Village* are the databases that get most hits; whereas *Science Citation Index*, *PCPDF* and *Chemical Abstracts* are the databases that share the longest network connection time.

(I.2) Electronic Journal Collection

(A) Periodical Collection – Chinese language

Most of the periodicals in Chinese language in Taiwan are still in printed format and it might be the only format that the library could get through subscription. To take the advantage of the Internet, more and more publishers setup the web sites to offer the information on the periodicals they publish, includes the table of contents, the feature articles and the full texts during past couple years. To make it easier for the library users to access those web sites, the Library has been collecting the information and making it available through the Homepages^{(3), (4)} of NCKU Library and NCKU Medical Library since 1997. Those periodicals could be accessed by the title list in which the items are arranged by the titles alphabetically, or by the subject list in which the items are arranged by the topics according to the Chinese classification scheme. At this point, the Library collects 700 titles and more than 66% of them are in sciences and engineering related subjects as shown in Table 2.

【Table 2: The Chinese Electronic Periodical Titles in the NCKU Library – by Chinese classification】

Classifi- cation	Gene- rality	Philo- sophy	Reli- gions	Natural Sciences	Applied Sciences	Social Sciences	Historic Geography(Chinese)	Historic Geography (Western)	Language Literature	Arts	Others
Title	89	5	29	72	235	159	4	6	22	64	15
%	12.71%	0.71%	4.14%	10.29%	33.57%	22.71%	0.57%	0.86%	3.14%	9.14%	2.14%

(B) Periodical Collection - Western Languages

As for the periodicals published outside of Taiwan, the NCKU Library orders several electronic publication services, such as EBSCO, ABI/Inform, IEL, EI Village, and IDEAL to expand the library collection. Besides those information systems, the Library also subscribes the electronic journals as well as the printed copies. As for year 2000 subscription, the Library subscribes 2,045 journal titles, while 769 of them are with electronic version. The distributions of electronic periodical titles are shown in Table 3.

【Table 3: The Western Electronic Periodical Titles in the NCKU Library– by Subjects】

Arts & Humanity	Science	Engi- neering	Electrical Engi- neering	Material	Civil Engineering	Urban Planning & Arch.	Management	Medical Sciences	Social Sciences	Other
15	37	33	99	29	8	27	89	334	29	69
1.95%	4.81%	4.29%	12.87%	3.77%	1.04%	3.51%	11.57%	43.43	3.77%	8.97%

At this point, the above data shows that NCKU Digital Library offers quite complete collection on the science and engineering related topics, but has little less collection in the areas of arts and humanities.

II. Information Literate Program

The second strategy of becoming a modern university library is to provide an information literate program for librarians and readers. It is known that the academic library programs are underpinned by the concept of information literate. As indicated in a final report of the American Library Association, although the information technologies have made the access function easier, there is still an on-going concern that most students are not information literate⁽⁵⁾. They are experiencing difficulties on recognizing which information is needed and where to locate, and/or evaluating and using the information correctly. These concerns are even more seriously now than in the past because the needs of knowledge and searching skills for information retrieving are growing exponentially.

The NCKU Library does recognize these concerns. Along with the library instruction programs scheduled frequently, the Library has also offered a regular course on Information Literate since 1992. It is a two-credit undergraduate course under General Education Program. The second author is the instructor of this course study. Many information resources and searching tools are introduced in this course study. It is noted that, this course teaches students how to recognize the information needs, define and articulate the needed information, and then,

find the information and use the information properly. Six topics or chapters are taught in this Information Literate course. These topics are (1)Literature and Information Society, (2)Library Services and Collections, (3)Access to Library Collections, (4)Reference Materials, (5)Information Retrieval, and (6)Library and Internet Resources.

More specific to the course contents, chapter (1) focusses on recognizing and analyzing the information needed. Chapter (2) gives an overview of the library services and library collections, and the automation systems of the NCKU Library. Chapter (3) introduces library acquisition, bibliography and circulation processes. Chapter (4) presents reference materials in various forms or formats. Chapter (5) focuses the electronic resources that the Library acquired, and Chapter (6) discusses the methods of information retrieval, and takes trial access to the internet resources. In summary, this course study of Information Literate teaches students firstly from recognizing and specifying the information needs, then teaches students the strategies to search among various related resources, and finally, helps students get the information successfully. It hopes that after taking this course the students could acquire the knowledge of utilizing library and becoming information literate.

An information of study behavior was conducted in 1999 to evaluate the progress of students who had taken this class. There were 67 students in the class. Results from students' self-evaluation questionnaires, instructor's observations, interviews and progress analysis, both at the beginning and at the end of that semester, are collected. Some findings obtained are presented and discussed as follows.

(II.1) The Participants

Since the Information Literate is one of the General Education courses in undergraduate study, the students who take this course are majoring in many disciplines. Due to the distribution of the student population of the NCKU, most of the students taking this course at that semester were from the College of Engineering. Besides, based on the students' academic year consideration, 45% of the students in the class were sophomores. The statistics of participants by knowledge background as well as by the academic year when they took this course study are shown in Table 4 and Table 5, respectively.

【 Table 4: Participants – Knowledge Background 】

Liberal Arts	Sciences	Engi-Neering	Manage-Ment	Medicine	Total
4	8	45	6	4	67
5.97%	11.94%	67.16%	8.96%	5.97%	100%

【 Table 5: Participants – Academic Year 】

Freshman	Sophomore	Junior	Senior	Total
17	30	11	9	67
25.37%	44.78%	16.42%	13.43%	100%

(II.2) Library Information Literate

At the beginning of that semester, each student was asked to fill out a questionnaire to help the instructor to get an idea on student's level of library information literate. It was found that, though most students were computer literate, most of them experienced difficulties on retrieving information, and most of them had very limited knowledge on information resources. The methods that most students used to get information were checking the textbooks, asking around and/or searching information by some available search engines, but usually failed or not successful. The following Table 6 summarizes some findings from the students' questionnaires or first self-evaluation reports at the beginning of the class, in which the weighted average is defined as an average value of the weight from one(no experience) to five(very familiar) as suggested by students.

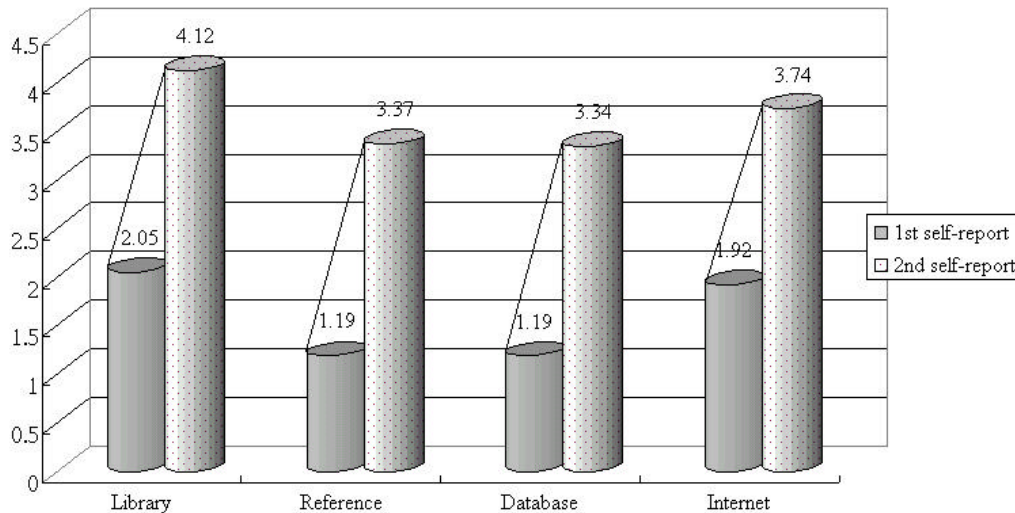
【 Table 6: Level of Library Information Literacy – at the Beginning of the Class 】

Experience	No				Very	Total

Category	Experience	Unfamiliar	Fair	Familiar	Familiar	Weighted Average
Library Collection	28	13	16	6	1	64
	43.75%	20.31%	25%	9.38%	1.56%	<u>2.05</u>
Reference Materials	55	6	3	0	0	64
	85.94%	9.38%	4.69%	0%	0%	<u>1.19</u>
Electronic Collection	54	8	2	0	0	64
	84.38%	12.50%	3.13%	0%	0%	<u>1.19</u>
Internet Resource	30	16	12	5	1	64
	46.88%	25%	18.75%	7.81%	1.56%	<u>1.92</u>

(II.3) Learning Progress

At the end of that semester, each student was asked to fill out second self-evaluation questionnaire or report. Besides the similar questions as those in the first self-evaluation questionnaire, they were also asked to rate the knowledge they had obtained in this course by the weight from one (very little) to five (very much). This learning progress expressed in weighted averages is shown in Fig.1. This figure shows that the weighted average of using the library collection increases from 2.05 to 4.12. The familiarity of the reference materials increases from 1.19 to 3.37. The access and use of the electronic collection and Internet resources increase respectively from 1.19 and 1.92 up to 3.34 and 3.74. Accordingly, the progress rate of using the library



【 Fig 1: The learning progress – by weighted average value 】

collection is 100.98%, utilizing the reference materials is 183.19%, accessing and using the electronic collection is 180.67%, and the Internet resources is 94.79%. From these results, students showed that they achieved the goal of taking this course study.

(II.4) The Usefulness of the Lectures

As mentioned above, there were six topics or chapters taught in the class of Information Literate. At the end of that semester, each student in the class was also asked to fill out another questionnaire to evaluate the usefulness of lectures. There were five subjects to be evaluated by students. These subjects were Analysis of Information Needs, Familiar with the Information Services, Searching the Library Catalog, Using the Reference Materials for Information Search, Utilizing the Electronic Collection for the Information on the Internet. The

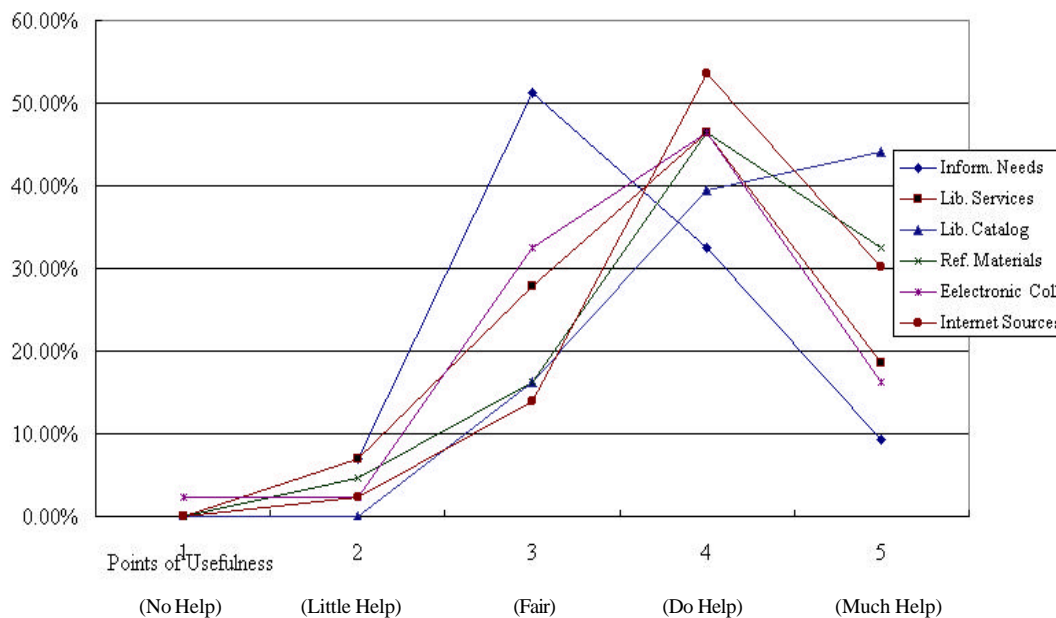
result of this course evaluation on the usefulness or impact of lecture topics is shown in Fig. 2. It indicates that most students consent to the usefulness of, and are benefited from this course study. The point or impact of the usefulness is generally over four, as indicated by "do help". Anyway, there still have a lot of rooms to improve the contents as well as teaching materials of this course.

It is worth to note that, the subject of Analyzing Information Needs seems not to attract students' attention. It seems to the instructor that students prefer acting on the instinct or by intuition, rather than go through several steps further to analyze the information they are seeking. Frankly, it would become useful when students need to have the knowledge to search for the information which is not clear enough.

As for using the Internet resources, since most of the students have experiences on surfing on the net, they do learn lots of knowledge to search the information on the Internet.

Another feedback from this class is that the students feel more confident when they come to the library for problem solving. This does encourage students come at ease to the library and use various information services,

% of participants(students)



【 Fig 2: The Impact of the Lecture Topics 】

because from this course study students learn more skill and familiar to use the library. Actually this is an important training of the life-long learning and study.

From the instructor's viewpoint, it seems that most of the students who took this course were information system literate rather than information literate. It means that students have pretty good skills in searching for the information sources, but they have questions on screening the most proper information they are seeking. This would be the subject that the instructor needs to pay more attention in the courseware work of this study.

6. Discussions and Conclusions

This paper firstly discusses the main features and functions of a modern university library. Then introduces the current status of information and communication network, as well as the academic network systems provided on Taiwan. The library automation, information retrieving and the service programs of National Cheng Kung University Library, Tainan, Taiwan are introduced, and the role and functions of a modern university library in supporting the modern engineering education and research work are also discussed. Two strategies as to build a digital library and to provide an information literate program are suggested for becoming a modern university library. The topics of a two-credit undergraduate course of Information Literate are presented, the impact or

usefulness of this course is discussed. It is concluded that, to teach students to be of library information literate would help their studies as well as the life-long learning and education.

7. References

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